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AUTHOR Tomlinson-Keasey, C.; Eisert, Debra
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ABSTRACT

Accent on Developing Abstract Processes of Thought (ADAPT) is a program designed to promote critical thinking among college students. Based on the theoretical work of Jean Piaget, it attempts to help University of Nebraska freshmen confront problems and follow them through to logical solutions. In its first year, the program's goals were to encourage abstract, formal thought patterns; to facilitate personal growth; and to cultivate positive attitudes toward the university. Various forms of evaluation showed that these goals were satisfactorily met. The second year's evaluation, conducted by means of better standardized and sounder assessments, largely confirmed the first year's findings. The ADAPT program seems to create a climate for exploration that positively influences student development along intellectual dimensions. These students, by being responsible for their learning, have acquired new thinking skills and have learned to savor the accomplishments that accompany the use of these skills. (Author/BP)

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DOING AND THINKING:

THEIR RELATIONSHIP IN COLLEGE FRESHMEN

C. Tomlinson-Keasey and Debra Eisert
University of Nebraska-Lincoln

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INTRODUCTION

For the past two years, a group of professors at the University of Nebraska have been perfecting a curriculum which demands that freshmen students be actively involved in their learning. This program, entitled Accent on Developing Abstract Processes of Thought (ADAPT), is aimed at encouraging students to be critical thinkers who are capable of confronting a problem and following that problem to a logical solution. The program takes its theoretical impetus from the writings of Jean Piaget who, with Barbel Inhelder, first traced the development of thinking from concrete and objective patterns to a more abstract level. Following Piaget's ideas, a central concern of the ADAPT program has been presenting concepts that are easily tied to familiar experiences and requiring that the students be active participants. These concrete experiences serve as a foundation for the gradual acquisition of a more generalized and abstract understanding of the concept. It is expected that a generalized understanding which is intertwined with experiences can then be applied to a variety of problems.

This brief sketch of the ADAPT program provides a context for understanding the goals of the programs.

As in the first year of the program, the primary goal was to encourage students to think critically and logically. Secondly, we were interested in providing sucessful learning experiences that would facilitate personal and social growth. Finally, we hoped that students who were being encouraged to explore a variety of content areas, would feel excitement in learning, and that this would be reflected in positive attitudes toward the whole university community. In short, our goals were to encourage abstract, formal thought patterns, to facilitate

personal growth, and to cultivate positive attitudes toward the university.

First Year Evaluation

The purpose of the present paper is to evaluate the success of the ADAPT program in achieving these goals. Before turning to the evaluation of the second year of the ADAPT program, a quick review of the evaluation of the first year of the ADAPT program is in order. Basically we found that ADAPT students demonstrated significantly more ability at formal reasoning processes at the end of the freshman year than a group of matched control subjects. It was further shown that the ADAPT students increased on a test of conceptual complexity while the control group decreased slightly. Finally, ADAPT students demonstrated very positive attitudes toward the faculty and their college experience. In short, it seemed that the goals of the ADAPT program were attained in the first year.

Given that the first year's evaluation indicated that many of the goals were being attained, it was decided that during the second year we should use more stringent measures of success. The measurement of change in abstract or formal operational thinking skills provides an example. During the first year a number of tasks were used which had been developed for research purposes. Although these tasks were theoretically geared to assess formal operational thought, they did not meet strict test construction requirements. It seemed that other nationally standardized tests of critical thinking might demonstrate more convincingly the value of the ADAPT program in fostering thinking skills. Hence, a nationally normed, objective test -- the Watson Glazer Critical Thinking Appraisal -- was administered during the second year.

A similar change with respect to the measure of personality development occurred. During the first year a test of conceptual complexity was used. This test, although used widely to assess interpersonal development, does not meet the parametric requirements typically demanded of nationally normed assessments. Here again, it was decided that ADAPT's success could be demonstrated convincingly if a more rigorous assessment was used. Hence, Jane Loevinger's measure of Ego Development became a part of the second year evaluation.

The thoughts of the evaluation team and project staff concerning the second year evaluation are reflected in these changes in measures. In essence, it seemed that the program successfully met its goals during the first year of its operation. In order to argue for wider dissemination of the principles of the ADAPT program, however, we felt compelled to put the program to a more rigorous evaluation. The results of this evaluation are reported in subsequent sections.

DESIGN OF THE EVALUATION

The evaluation instruments used, the different groups of subjects involved in the assessments, and the times when various tests were administered are depicted in Table 1. In subsequent sections the tests and subject samples are described and the rationale for the design is given.

Instruments

1. Watson-Glazer Critical Thinking Appraisal. This test consists of a series of exercises which require the application of some of the important abilities involved in critical thinking: inference; recognition

TABLE 1

Design of the Second Year Evaluation

	ADAPT Students		Control Students[1]		Centennial Students		Control Students[2]	
	Fall 1976	Spring 1977	Fall 1976	Spring 1977	Fall 1976	Spring 1977	Fall 1976	Spring 1977
Initial Measures								
ACT Scores	X		X		X		X	
H.S. Quartile	X		X		X		X	
Watson-Glazer Critical Thinking Appraisal	X	X	X	X	X	X		
Formal Operational Assessments	X	X					X	X
Jane Loevinger's Ego Development	X	X	X	X	X	X		
Omnibus Personality Inventory	X							
Attitudes toward Faculty		X		X		X		

of assumptions; deduction; interpretation; and evaluation of arguments. In addition, the critical thinking appraisal calls for responses to two different kinds of items. In some items the student confronts problems involving neutral topics about which people generally do not have strong feelings. Other items, approximately parallel in logical structure, pertain to political, economic, and social issues which are more likely to arouse emotional feelings, biases, or prejudices (Watson & Glazer, 1964).

This test has been administered to 5,675 freshmen in 16 liberal arts colleges. Hence, norms for the performance of freshmen are available. In addition, reliability and validity data have been compiled. Finally, the Watson-Glazer is available in multiple forms. Using two forms for pre- and post-testing has the advantage of minimizing any practice effects.

In essence, the use of the Watson-Glazer Critical Thinking Appraisal allows for a rigorous test of whether any changes have occurred in thinking skills as a result of the ADAPT program. It is hypothesized that the ADAPT students will show significantly greater increases on the Watson-Glazer Critical Thinking Appraisal than the Control or Centennial subjects

2. Formal Operational Tasks. The instruments used to assess formal operations consisted of five tasks which require proportional reasoning, isolation and separation of variables, correlation, and probability.(Campbell, 1977). This test is designed to assess the theoretical formulations of Jean Piaget. Our goal in using this type of assessment was to adhere as closely as possible to theoretically meaningful assessment procedures.

3. Attitude toward Faculty

To assess the students' attitude toward faculty, that subscale of the College Student Questionnaire, Part II was administered. This standardized attitude questionnaire allows for comparisons between the ADAPT, control, and Centennial samples as well as a comparison of the three groups with a national sample. The specific hypothesis to be investigated is that the ADAPT population has more positive attitudes toward the faculty than the Control 1 group or the Centennial students.

4. Omnibus Personality Inventory.

This personality test emerged from the extensive work on college student development by Sandford (1956) and his associates at Vassar after World War II. Extensive data have been accumulated concerning this test by the staff of the Center for Research and Development in Higher Education at Berkeley. The test was selected because it examines both the intellectual and emotional aspects of personality. However, since it is more likely to indicate personality development over a long period of time, it was decided that it should not be administered a second time until the junior or senior year.

5. Ego Development

A test which is somewhat more likely to show short term development is Jane Loevinger's Measure of Ego Development. This instrument indicates the degree to which mature personality characteristics have developed. In effect, personality is charted through various response types, each one characteristic of students whose personal development has progressed to a similar degree. This assessment, like the Watson-Glazer, has a long history of use and seems to be one of the most reliable and valid indices of personality development that is currently available (Loevinger, 1976). In addition, the theoretical and developmental

aspects of this test mesh nicely with the principles of the ADAPT program. In short, the results of this test given during the fall and spring should provide a rigorous test of the hypothesis that the ADAPT program facilitates affective development

6. Initial Measures

Since the selection procedures for the four groups of subjects did not guarantee a random sample of the entering class of freshmen, it is important to know how the groups differ on initial characteristics. The pre-test assessments will, of course, give some indication of the differential standing of the four samples. In addition, it is possible to compare all four groups on the American College Test (ACT) and high school standing. The ACT has the advantage of being a widely used and well standardized test, enabling us to compare our groups to national norms. Such comparisons may help establish the generality of our results.

Subjects

A total of four different groups of subjects participated in the 1976-77 evaluation. Changes in the ADAPT students on various measures were compared to changes in three control groups. The first control group was composed of students who had indicated an interest in the ADAPT program, but for a variety of reasons had decided not to enroll. The comparison of this group, labeled $Control_1$, with the ADAPT students is perhaps the most appropriate and meaningful comparison of the effects of the freshman year. However, the $Control_1$ students' freshman year differs from the ADAPT year in a variety of ways. Classes are typically larger, the students are more likely to be taught by graduate assistants, opportunities for discussion are probably more limited, and they may

have few acquaintances in a class. Because any of these variables could be a factor in differences between the ADAPT and Control$_1$ groups, a second comparison group of Centennial students was selected.

In the Centennial education program, as in the ADAPT program, students are in small classes, they are encouraged to participate in class, they often know each other, and the professor is likely to be very skilled. Comparing this group to the ADAPT group seemed like a more reasonable test of whether the ADAPT curriculum was effective in moving students toward more abstract thought processes.

As indicated in Table 1, these three groups (ADAPT, Control$_1$, and Centennial) participated in the Critical Thinking and Ego Development testing during both the Fall of 1976 and the Spring of 1977. In addition, attitudes toward faculty were measured in the Spring in all three groups.

Because the ADAPT program was designed to increase formal operational thinking and because there were no preliminary indications of how these abstract thinking skills might correlate with those processes measured on the Watson-Glazer Critical Thinking Appraisal, it was decided that a separate comparison of movement on formal operations would be appropriate. Two sections of the same introductory physics course, one containing ADAPT students, and one composed primarily of sophomores who received a traditional physics course (Control group 2) made this comparison possible. The test of formal operations was administered as part of the physics laboratory in the fall and spring.

RESULTS

The results are divided into five sections: (a) a comparison of groups on initial measures; (b) an evaluation of changes in thinking skills; (c) an evaluation of changes in personality development; (d) a comparison of attitudes toward faculty; and (e) a compilation and summary of two years of the ADAPT program

Initial Measures

In Table 2 the high school quartiles are listed for each of the four student groups.

TABLE 2

High School Quartiles of Students in All Groups

	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter	
	N	%	N	%	N	%	N	%
ADAPT (n=30)	12	40	11	36.7	4	13.3	3	10
Control 1 (n=31)	23	74.2	6	19.4	1	3.2	1	3.2
Centennial (n=25)	13	52	7	28	3	12	2	8
Control 2 (n=18)	13	72.2	5	27.8	0	0	0	0
All Nebraska Freshmen 1977 (n=		47		35		13		5

It's clear from these data that the control groups are a more select group relative to either the ADAPT or Centennial samples. The ADAPT group has the smallest percentage of students from the upper quarter of the high school graduating class. From these data we might expect pre-test differences between our groups and we can clearly see that the two control groups do not represent a random sample of the entering freshman class.

ACT test scores were also available on most of the students. These scores are presented in Table 3.

TABLE 3

Means and Standard Deviations of Four Groups on ACT

	ACT Composite	Eng	Math	Social Science	Natural Science
ADAPT n=31	20.22 (4.70)	17.61 (4.42)	19.71 (6.08)	22.77 (5.75)	20.10 (6.56)
Control 1 n=34	24.12 (5.54)	21.68 (5.53)	23.29 (8.26)	26.44 (5.67)	24.56 (5.89)
Centennial n=24	23.21 (6.01)	21.50 (4.63)	22.58 (9.57)	24.79 (7.03)	23.63 (6.63)
Control 2 n=13	23.85 (3.56)	20.92 (5.30)	25.77 (4.42)	25.15 (5.47)	23.23 (5.02)
All UNL Freshmen n= 3,000	21.2	19.0	21.6	20.1	23.4
Nationwide sample n=48,808	18.5	17.6	17.8	17.4	20.9

The disparity between the scores of the ADAPT students and all three of the other control groups is obvious. The ADAPT group's scores are significantly lower than the other three groups on the composite measure.

The ACT scores confirm the fact that the ADAPT group is less able in a variety of content areas than the other three groups of students that were followed in the present study. The Centennial students who, on the basis of high school rank, might be expected to do poorly on the ACT did not differ from the $Control_1$ or $Control_2$ subjects.

It seems clear from these initial measures that the students selecting the ADAPT program were not as well prepared for college as the other three control groups. Their ACT scores are also lower than the overall freshman class entering the University of Nebraska at Lincoln.

Changes in Thinking Skills

The ADAPT group and $Control_2$ group were administered five different formal operational tasks in the fall and the spring of the year. On each of these tasks, students could receive a score from 1 to 5. In each case a score of 1 or 2 meant that a student relied primarily on concrete thought processes to solve the problem; a score of 3 or 4 indicated that the student was in transition from concrete to formal operations; and a score of 5 meant that the student used formal operational thought in solving the problem. A composite score obtained by averaging a student's performance across all five tasks gives a global indication of the kinds of thought proceses students used to solve a variety of problems.

As indicated in Table 4 this composite score shows that the two groups differed significantly $F(1,48) = 5.19$, $p < .03$ and that there was a significant increase in formal operational skill from fall to spring $F(1,48) = 28.49$, $p < .01$

TABLE 4

Formal Operational Scores of ADAPT and $Control_2$ Students

	ADAPT n=30		Control n=20		Group F	Time F	Interaction
	Fall	Spring	Fall	Spring			
Metric Puzzle	3.68	4.61	4.65	4.75	6.73**	7.77**	5.05*
Apartment Puzzle	3.90	4.03	4.02	4.35			
Algae Puzzle	2.83	3.70	3.05	3.60		30.57**	
Flexibility of Rods	3.68	3.96	4.32	4.35	12.55**		
Coin Toss	3.03	3.48	3.37	3.63		4.31*	
Composite Score	3.43	3.94	3.90	4.13	5.19*	28.49**	4.32*

* $p < .05$
** $p < .01$

These results document increases in formal operational skills for both groups from fall to spring. Such a change should certainly be expected during the course of a year in college. In addition, this analysis demonstrates a significant difference between the ADAPT and $Control_2$ subjects. The initial measures reported earlier revealed a significant disparity between the ADAPT and $Control_2$ subjects. Hence, it is not surprising that the ADAPT students scored somewhat below the

$Control_2$ students on the pretest. The significant interaction between the groups and the the pre- and post-tests, however, indicates a differential increase during the year in the two groups $F(1,48) = 4.32$, $p < .05$ Basically, this result, depicted in Figure 1, indicates that the ADAPT students showed more substantial increases in formal operational thought than the control subjects.

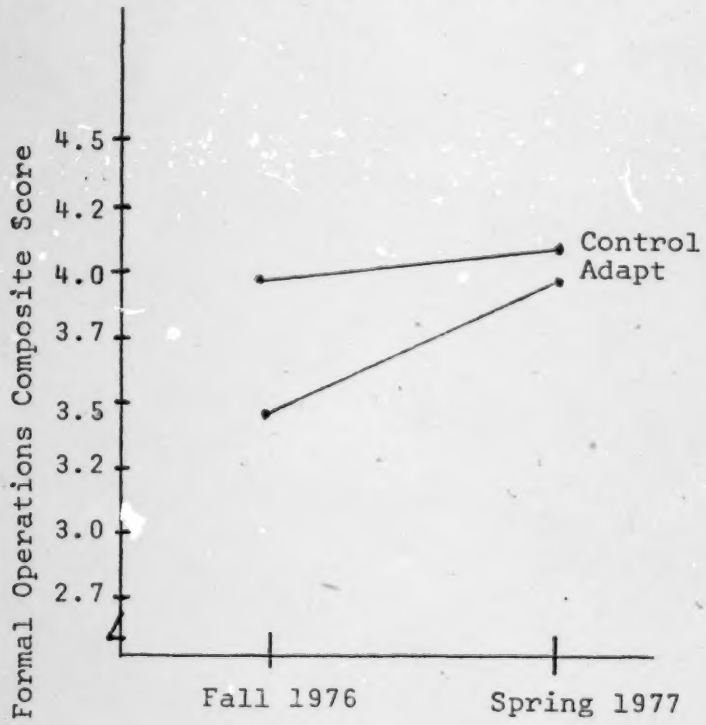

Figure 1. Changes in Formal Operational Thinking

The Watson-Glazer Critical Thinking Appraisal was also administered to chart the effect of the ADAPT program on thinking skills. Forms Y and Z of the Watson-Glazer were administered in the Fall and Spring respectively to ADAPT, $Control_1$, and Centennial students. Although these two forms are equivalent when percentile scores are used, the

raw scores on form Z are somewhat lower than the raw scores on form Y. Hence to avoid showing a spurious drop in raw scores all post-test scores were converted into scores equivalent to the pre-test form. The means and standard deviations of the three groups are reported in Table 5.

TABLE 5

Means and Standard Deviations of Watson-Glazer Test Scores

	ADAPT	Control$_1$	Centennial
Pre-test	63.60 (8.23)	74.54 (8.39)	73.75 (10.09)
Post-test	73.26 (10.49)	74.97 (10 02)	74.00 (11.70)

A repeated measures analysis of variance indicates that the interaction between the three groups and the two tests is significant $F(2,95) = 4.13$, $p < .019$. This indicates that the ADAPT students made significant gains during the year while the other two groups did not. Althought the ADAPT students were less able on the pre-test, by the end of the year they had improved significantly in critical thinking skills and their scores now equaled the scores of the other two groups.

In this section of the results the ADAPT students have been compared with three other groups on two measures of abstract thought. In all of these comparisons the ADAPT students have shown increases in thinking skills that were not matched by the comparison groups. One can attribute these increases to the methods and rationale underlying the ADAPT program but there is at least one alternative explanation that

warrants consideration.

These results could be a function of a ceiling level on the measures used. In other words, the control students who on the pre-test were far superior to the ADAPT students might not have been able to improve their scores on the post-test. Considering this criticism for the formal operations measure we see that the control students composite score was 3.95 on a scale of 5. However, an examination of the subscales reported in Table 4 indicates that on only one of the tests had the control group really reached a ceiling level. Therefore, they could have shown movement on the other four post-tests. Another factor which seems to render this criticism inapplicable to the formal operations test is that the ADAPT group had also reached a ceiling on the post-test of the metric puzzle. On the critical thinking appraisal, the control students' post-test scores were approximately 73 out of a possible 100. National norms indicate that students scoring in the upper 10% of the population receive raw scores of 79-89 with a raw score of 89 representing the 99th percentile. The control group should have been able to achieve raw scores in the 79-89 range if their critical thinkings skills had improved. Hence, it does not seem likely that a ceiling effect can account for the lack of change demonstrated by the two comparison groups on the critical thinking measures.

Another explanation, buttressed by the first year ADAPT evaluation results, is that the ADAPT curriculum is designed to foster critical thinking skills while a more typical freshman curriculum does not.

Personality Development

The changes in Jane Loevinger's measure of ego development from fall to spring are depicted in Table 6. An analysis of these means indicates no significant change on the part of any of the groups.

TABLE 6

Means and Standard Deviations of
All Groups on Ego Development

	ADAPT		Control		Centennial	
	Male	Female	Male	Female	Male	Female
Pretest						
$\bar{X}$	4.95	5.47	5.38	5.48	5.06	5.64
σ	.78	.52	1.41	.70	1.64	.67
Posttest						
$\bar{X}$	4.84	5.13	4.88	5.48	5.06	5.09
σ	1.46	.60	1.36	.89	1.25	.83

One can conclude that the ADAPT program did not foster any substantial changes in personality development as measured on this test.

Attitudes toward Faculty

In the first year evaluation of the ADAPT program, attitudes toward ADAPT faculty were very favorable. Since such attitudes permeate a student's college career, the second year evaluation looked again at ADAPT, Control, and Centennial students' attitudes toward faculty (subscale of College Student Questionnaire, Part 2). The difference between the three groups' attitudes, reported in Table 6, are highly significant $F(2,91) = 14.29$, $p < .001$

TABLE 7

Attitudes toward Faculty

	ADAPT	Control	Centennial
$\bar{X}$	36.03	30.57	37.71
σ	4.75	5.89	6.13

Both the ADAPT and Centennial students gave very favorable ratings to the faculty while the Control students, involved in larger classes and typically experiencing much less interaction with the faculty, are not as favorably disposed toward the faculty.

These attitudinal results by themselves might suggest that the variables of interest are quality faculty and small classes. However, when these results are examined in concert with the changes in thinking skills presented earlier, we do not see substantial increases in the Centennial group. Hence, one can conclude that something other than quality faculty and small classes is operating to effect the changes in the ADAPT students. We would like to suggest

that a critical variable is the curriculum which demands that the student (a) engage in some exploration of an area, (b) relate his explorations to meaningful experiences, and then (c) apply these concepts broadly.

COMPILATION AND SUMMARY OF TWO YEARS OF THE ADAPT PROGRAM

The two years of the ADAPT program have been very different in many ways, yet some of the same patterns of growth have emerged. In this section an attempt is made to compare the findings from the two years and summarize them.

The two groups of ADAPT students are compared on ACT scores in Table 7. While the composite scores are not significantly different, this year's group of ADAPT students received lower scores than last year's on all of the sub-tests except social science.

Table 8

Means and Standard Deviations of ADAPT Groups on ACT

		Composite	Eng	Math	Social Science	Natural Science
ADAPT 75-76	$\bar{X}$	21.24	18.85	20.85	21.29	23.81
		4.94	4.99	6.93	5.78	5.81
ADAPT 76-77	$\bar{X}$	20.22	17.61	19.71	22.77	20.10
		4.70	4.42	6.08	5.75	6.56

Perhaps one could argue that the 1976-77 group of ADAPT students was not as well prepared for college as the 1975-76 group. The fact that students from both years showed improvements in abstract thought that were not paralleled by students enrolled in a more traditional

curriculum seems to argue that the ADAPT program can provide a focus for facilitating the development of critical thought processes across a broad spectrum of student abilities. In both years of the program we see that students in the ADAPT program have a much more favorable attitude toward the faculty than students in a traditional curriculum.

In short, the second year of the ADAPT program, evaluated by means of better standardized and sounder assessments, largely confirmed the findings of the first year. The ADAPT program seems to create a climate for exploration that positively influences student development along intellectual dimensions. These students, by being responsible for their learning, have acquired new thinking skills and have learned to savor the accomplishments that accompany the use of these skills.

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